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CENTRAL INTELLIGENCE AGENCY

INFORMATION REPORT

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[redacted]

[redacted] Comments:

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1. Throughout, read Zverev instead of Sveryev.
2. Throughout, read Kikoin instead of Kikoyen.
3. Throughout, read Ikert instead of Ickert.
4. Throughout, read Beriya instead of Beria.
5. Throughout, read Siewert instead of Sievert.
6. Throughout, read Kuznetsov instead of Kusnitsov.
7. Throughout, read Kvartsava instead of Kortsava.

C-O-N-F-I-D-E-N-T-I-A-L

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COUNTRY USSR [redacted] RT [redacted]

TOPIC Soviet Atomic Energy Program at the Hertz Institute in Agudzeri

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I. Institute of Professor Hertz, August 1945 - October 1952

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I. The Hertz Institute, August 1945 - October 1952

Fields of Activity

1. The very basis of all work performed at the Hertz Institute was the Smyth Report. This report was made available to the Germans on their arrival in Agudzeri. They very carefully studied the new field opned to them by this report until the spring of 1946 and each of them took to a special line of approach to the different nuclear problems. In April 1946, the following tasks were posed by Moscow:

   a) Development of isotope separation methods

   b) Development of diaphragms for diffusion purposes

   c) Development of measuring facilities of different types for isotope measurements.

   The order was sent by the MVD 9th Chief Directorate, and for the first time the names of Lieutenant General Sveryev (fnu) (phonetic spelling) and Zavenyagin (fnu) (phonetic spelling) were mentioned. Prizes and bonuses were promised. Suspension dates were not fixed.

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3. The organizational setup of the institute was organized according to the different objectives chosen by the members of the institute and individual laboratories were assigned to each of them. Each laboratory chief was assisted by noncommissioned members of the team and by PWs which arrived later. Hertz gave a free hand to every laboratory chief and was kept informed on the work's progress by monthly reports.

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Engineering of the manufacture of metal foil diaphragms by evaporation

4. [redacted] 25X1

5. The main point of his project was the production of an alloy with the highest possible content of constituents to be evaporated. [redacted] 25X1

6. In the spring of 1946, systematic experimental work was started. Adequate quantities of silver, zinc and cadmium as well as a suitable smelting furnace had been captured by the Soviets in Germany. The first smelting experiments were designed to determine the mixture ratio for a rollable alloy. It was found that an admixture of 50 percent zinc or cadmium still yielded a rollable material.

7. The smelting was carried out in a Tamma-type furnace. A quantity of about 300 grams of a silver-zinc-cadmium alloy was manufactured, which was first hot-rolled for the purpose of destroying the internal structure of the alloy. Then the alloy was cold-rolled to strips 0.1 mm thick, 6 cm wide, and 1 - 1.5 meters long with the use of a 20-cm double-roll mill which had been dismantled at Bumm's former metallurgical laboratory at Berlin-Siemensstadt. The metal foil thus obtained was then cut into squares measuring some centimeters across. These squares were annealed in a vacuum at different temperatures. The zinc was found to evaporate visibly at a temperature of between 250 and 300 degrees centigrade. **Complete** evaporation was accomplished within 3 to 4 hours. It was also found that an admixture of cadmium promoted the evaporation process.

8. The [redacted] method of manufacturing porous metal foils was a feasible one. It was also found that the annealing process was to be carried out at high temperatures since the pores showed a tendency to plug up at low temperatures. 25X1

[redacted] 25X1

Porosity requirements and measurements

9. The first porosity requirements were fixed by the Soviets in early 1947. [redacted] 25X1 their requirements proved later to be faulty. In 25X1 January and February 1947, an adequate measuring method had not yet been developed and the properties of the diaphragms developed by [redacted] members of the team could not be tested. 25X1

10. Hertz constructed the first measuring device. [redacted] 25X1 25X1 The diaphragm was clamped between two rubber rings and 25X1 inserted into the measuring chamber located between two air containers. One of the containers was evacuated. By opening a stopcock, the air from the unevacuated container diffused through the diaphragm to the evacuated side. The pressure drop was indicated by a gauge. The containers had a 5-liter capacity, the pressure used was 100 Thor. The diaphragm surface was about 2 sq.cm. The first measurements made it quite clar that this device was suited only for the making of quantitative measurements. Besides, the results were quite inexact due to accumulation at the stopcocks.

11. [redacted] 25X1

12.

13.

[redacted] 25X1

14. [redacted]

Manufacture of tubular diaphragms

15. In the summer of 1947, new requirements were raised by the Soviets. Instead of flat diaphragms, they now requested tubular diaphragms. A tube diameter of 12 - 20 cm and a length of about 1/2 meter was demanded. This mission disclosed that professor Kikoyen (fnu) (phonetic spelling), chief of Laboratory 2 in Moscow, was the leading figure in Soviet isotope separation projects. He was said to have set up an experimental cascade operated with sintered iron diaphragms delivered by an undetermined factory. It is believed that Kikoyen discontinued experimenting with flat diaphragms in the summer of 1947. A hole diameter of 0.5μ was prescribed for the tabular diaphragms.

16. [redacted] 25X1

17. [redacted]

Development of metal diaphragms by etchin and with the use of metal screen material by Reichmann

18. [redacted] Reichmann systematically investigated the possibilities of developing a metal diaphragm. Until October 1946, he made attempts to reach this objective chemically. Brass sheets were immersed into hydrochloric acid baths of different degrees of concentration. In order to remove the oxide coat covering the brass sheets, 1 percent nitric acid was added to the hydrochloric acid. The foils obtained were of good porosity but very brittle. 25X1

19. In October 1946, Reichmann started experiments on another method. Copper powder was rolled onto a copper screen. In the first sintering stage, the workpiece was annealed at low temperature in a hydrogen atmosphere. The resulting adhesion of the crystals increased the density of the foil. As far as was remembered, the copper screen had 3,000 to 5,000 loops per square centimeter. The screen material had been captured by the Soviets at the Siemens laboratory at Berlin/Siemensstadt. The porosity of the foil thus obtained was good but the distribution of the holes still left much to be desired, and its thickness was uneven due to the hand-operated rolling process.

20. Reichmann subsequently conducted experiments with a finer copper powder which he had precipitated himself. The rolling process was also improved by using better rolls. A uniformly thick and porous foil was obtained which was submitted to analysis in Moscow at the turn of the year 1946/47. By this time, Thiessen had developed another type of copper foil obtained by applying copper powder to copper screen. This foil was also examined in Moscow and proved to be superior in quality to Reichmann's. The Soviets ordered the development of a nickel foil on the same basis.

Corrosion experiments and experiences

21. The Soviets are believed to have gathered their first experiences on the corrosion effects of the material used in the cascade in early 1947. Supposedly these experiences were made while using UF_6 in the cascade at Laboratory 2. [redacted] 25X1 [redacted] the corrosion problem might spoil all work. Only Ickert and Zuehlke started early investigations of this problem. 25X1

22. Ickert inserted a foil suspended from a quartz coil into a glass tube. This tube was then evacuated and refilled with UF_6. After a week, the action of the UF_6 on the foil was determined by weight measurements. It was found that the UF_6 vigorously attacked the foil during the first 3 days. After these days, the weight curve remained constant and no further weight losses were to be detected. Because of the delicacy of the quartz coil the weight of the foil samples had to be kept below 2 or 3 grs.

23. Zuehlke investigated the corrosion problem by carrying out comparative measurements of pressure changes in a closed metal unit consisting of two cylinders. Initially these cylinders were made of copper, later nickel cylinders were used. A foil measuring some 100 square centimeters was inserted into one of the cylinders. Both cylinders were then evacuated and refilled with gaseous UF_6 until a pressure of 10 - 20 Thor was established. The cylinder housing the foil showed a rise in pressure due to decomposition of the foil. The pressure within the other cylinder remained constant. The UF_6 was delivered in 20-liter steel containers arriving from Moscow. It was said to be naturally occurring UF_6. The first shipments were observed in 1947.

24. Around mid-1947, it was generally agreed that Zuehlke's method was superior to Ickert's. It was found that pure nickel has the highest resistance to corrosion by UF_6. Nickel-plated samples also proved adequate. Surface treatment of the nickel by high-polishing further raised the corrosion resistance. Very thin nickel layers of some 20μ proved to have greater protective properties than layers of 100 - 200μ thickness.

<u>Development of diaphragm tubes by Reichmann</u>

25. In early 1947, Reichmann started work on the development of tubular nickel screen diaphragms. The Soviets had captured a large stock of nickel screen in Berlin/Siemensstadt where the screen had been designed for the manufacture of filters and sieves. The density of the loops was about 5,000 per square centimeter. Reichmann and Thieme bitterly disputed against each other for this nickel screen material until the Soviets ordered equal distribution of the amount to both of them. After having received his portion, Thiessen instantly requested more nickel screen material from the 9th Chief Directorate. Material procurement was a difficult problem since nickel screen had to be imported from Germany. The Soviets started their own production of nickel wire, but the manufacture of screens was carried out in East Germany. By late 1947, nickel screen material was delivered in small quantities.

26. Reichmann made an attempt to obtain a fine-grained nickel powder from nickel oxide, and also from nickel oxalate produced at his laboratory. He manufactured nickel oxide of different grain size, which was subjected to a reduction process. Decomposition of nickel oxalate by exposure to air yielded a nickel metal powder which was moistened with alcohol. But even without moistening this powder easily adhered to the nickel screen. This nickel-powdered nickel screen was annealed in hydrogen. The first experiments yielded foils too dense and of uneven thickness. Reichmann carefully investigated the causes of the failure and found that the workpiece "afterglowed" after the annealing process when exposed to the air, (so-called pyrofority of the powder). Oxides formed by the afterglowing phenomenon caused plugging-up of the screen holes. By using a coarser grain powder and by tempering the workpiece at room temperature, this pyrofority was prevented.

27. The first measuring results of this diaphragm in the summer of 1947 revealed that Thiessen had been more successful than Reichmann. He worked with nickel carbonyl powder. Reichmann further delved into the matter and manufactured an unpressed sintered workpiece. But this method also proved inadequate.

28. After September 1947, Reichmann again took up the use of nickel powder. Blending it with tragacanth, he obtained a paste which was extruded in tubular shape with the use of a 10-ton press which had been dismantled in Berlin/Siemensstadt. This press was replaced by a Soviet 50-ton press in late 1947. The first tubes were slightly distorted. Their wall thickness was 2 mm, their length 0.5 meter.The Soviets appeared impressed by this new design and called it "maccaroni". The porosity was tested with the use of alcohol. The simplicity of the production method was greatly appreciated.

29. In January 1948, large-scale production of diaphragm tubes was under discussion. The first samples had shown that the pressing molds were inadequate. The Soviets were eager to cooperate and, in January 1948, a more suitable mold was delivered from the Ceramics Institute in Moscow. This pressing mold was double-walled, 15 to 16 mm in diameter, the interstice between the two walls measured 0.5 mm. The nickel-tragacanth mass was filled into the mold and extruded. The small thickness of the extruded tubes was gradually reduced in the months following the first experiments. The final wall thickness reached is believed to have been 0.1 mm. No technical obstacles were met. The resulting tubes were elastic, their water content was extracted by dipping them into acetone before the final sintering process.

30. In the spring of 1948, the first tubes were delivered to Laboratory 2 in Moscow for measuring purposes. The findings were most satisfactory and Reichmann was ordered to report in Moscow. He was ordered to develop a large-scale production project with a daily capacity of 500 items. Reichmann returned in high spirits and started this project which confronted him with great difficulties in the procurement of material, tools and labor force. In the summer of 1948, he died of a heart attack. 25X1

31.

Porosity requirements and Zuehlke's measuring method

32. The first porosity requirements were fixed by the Soviets in the summer of 1948. They were expressed in terms of gamma and delta. Delta values are related to the pressure relations and expressed in terms of 20 - 80 Thor. Gamma values are related to the permeability. [redacted] 25X1 25X1 A value of 1.8 played an important role by that time. The porosity requirements were set up at Moscow, presumably by Laboratory 2. Apparently the Soviets were not interested in grain size determination. Their interest was focussed on the production of tubes. Grain sizes were of secondary importance since it had been proved in principle that the porosity reached was adequate to achieve isotope separation.

33. By late 1947, Zuehlke had developed an absolute analysis capable of measuring the actual separating factor. No details are available. Zuehlke's work was greatly appreciated by the Soviets and was apparently accepted as the method of choice. In the summer of 1948, Zuehlke was ordered to examine the method developed by the Soviets themselves in Moscow, presumably at Laboratory 2. The development of an exact measuring method is believed to have played a decisive role in the isotope separation project.

Acceptance of diaphragm tubes by the Soviets

34. As a result of the improved production methods, a daily output of 50 diaphragms was reached. Early in the autumn of 1948 [redacted] 25X1 turned the laboratory over to the Soviet Yermin (fnu) (phonetic spelling) who, in late 1948, received the first order for a daily production of 300 test diaphragms. In order to be able to meet the demands, the laboratory had to be equipped with new sintering furnaces and hydrogen. The furnaces were of Soviet make after Siemens type furnaces, 50 cm long sheet metal furnaces with fire-clay lining, heated by a nichrom coil, the sintering temperature being controlled by a thermocouple element. Yermin was assisted in his work by the institute.

35. The delivery date for this first order, which was fixed for early 1949, could not be met. Sveryev thereupon personally visited the institute and "stepped on Hertz's feet", although the failure was due to Yermin's inefficiency. [redacted] 25X1 25X1 In May 1949, the first production order was filled. Another order for 3,000 to 4,000 items was completed in the autumn of 1949.

36. Analyses of the diaphragms in Moscow revealed a very high rate of rejects. [redacted] the cause of this high reject 25X1 rate [redacted] was attributed to the deficient training and 25X1 indifference of the Soviet workers. Careless handling caused

contamination of the nickel oxide powder during the production process as well as during the grinding process. The finished diaphragms were packed and shipped to an unidentified Moscow address. It was generally assumed that Laboratory 2 was the recipient.

37. Yermin was transferred to Moscow in the autumn of 1949 where he was believed to have been made chief of a new production shop of Reichmann diaphragms. He was not accompanied by any German experts.

The use of diaphragm tubes in the cascade

38. Early in the summer of 1949, the Soviet met with great difficulties in assembling the diaphragms into the cascade. Moscow complained that the tube ends consistently broke. [redacted] 25X1 [redacted] 25X1 The problem of how to suspend the diaphragm holder tube in the cascade was solved by flanging the holder tube into the cascade top.

Hertz's diaphragm project

39. Early in 1946, Hertz developed a project for manufacturing a copper alloy diaphragm. Assisted by his son, he worked on this project until early 1947. This work was discontinued when the Soviets ordered the development of a nickel diaphragm.

Thiessen's diaphragm project

40. As early as the summer of 1947, Thiessen had started the production of diaphragms. No details are available. His method was said to be very similar to Reichmann's. According to some [redacted] 25X1 Thiessen always spied on Reichmann. Until Reichmann's development of the diaphragm press, they were practically abreast with one another. Thiessen's success in developing a nickel diaphragm on the basis of nickel screen was largely due to the efficient support by his chemical colleagues who provided him with pure nickel powder. In the autumn of 1947, he was in a position to deliver his first 200-300 nickel diaphragm tubes to Moscow for analysis. Assuming that Reichmann's tubes were equal in quality to Thiessen's, it may be said that Thiessen was one year ahead of Reichmann.

41. [redacted] Thiessen's diaphragms 25X1 did not come up to expectations. The first pumping experiments in the cascade proved that the nickel powder partly disintegrated from the nickel screen. [redacted] 25X1

[redacted] 25X1
[redacted] professor Kikoyen is considered to be the leading 25X1
expert in Soviet cascade work. Laboratory 2 is engaged in diaphragm production, porosity measurements, corrosion tests and cascade experiments. [redacted] 25X1

The diffusion plant

42. It may be assumed that a large-scale cascade plant was developed at Laboratory 2 under Kikoyen. This plant is believed to have been set up at a locality in the Ural-Sverdlovsk area between 1948 and 1949. In October 1949, Hertz, Muehlenpfordt, Schuetze, Barwich, and Thiessen were ordered to report in Moscow. They were taken by plane in the direction of Sverdlovsk. [redacted] 25X1
[redacted] they had been ordered to solve difficulties which 25X1
had arisen at the cascade plant in "Kefir Town". Before leaving Moscow, they had attended a conference headed by Beria in which the difficulties in the operation of a cascade had been laid out.

43. The difficulties encountered at the "Kefir Town" cascade were apparently closely related to the work of those German experts which had been ordered to Moscow. Schuetze's mass-spectrograph had failed to indicate the degree of enrichment at the different stages. This failure was proved to be due to the Soviets lack of ability to operate the apparatus properly. Hertz and Muehlenpfordt were expected to elaborate on their own ideas regarding the cascade plant. Barwich and Thiessen were to solve corrosion problems arising at the diaphragms and the pumps. Hertz and Muehlenpfordt returned to Agudzeri after three days. Schuetze remained in Kefir Town for about one week, while Barwich and Thiessen worked there for three months.

[redacted] 25X1

44. Around mid-1948, rumours spread at the Agudzeri institute that "it had proved extremely difficult to keep the cascade vacuum-tight". At the same time, Dr. Sievert (fnu) conducted vacuum experiments with the use of rubber and Teflon.

45. After the return of the "Kefir Town Inspectors" it was generally assumed that Soviets had been successful in overcoming their cascade troubles. No further information was received.

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Data on Hertz's Isotope Separation Method

53. [redacted] 25X1
[redacted] Hertz chiefly developed his isotope separation project on a scientific-theoretical scale. He is a theorist rather than an experimenter. Realization of his ideas largely depended on their being carried out by an experienced assistant with a practical mind. The fact that no such person was at his disposal at Agudzeri greatly hampered his success. His Soviet co-workers were of substandard knowledge and training and of remarkable indolence. They were unable to carry out independently even the most simple experiment. 25X1

54. Hertz's isotope separation method which was based on the countercurrent flow principle was said to have worked fairly well in principle. But difficulties arose as soon as two or three separation chambers (Hertz called them pumps) were connected in series. Then no separation factor was obtained. [redacted] 25X1
[redacted] Hertz was unable to overcome these difficulties prior to 1952. They were caused by leaks in the diffusion system or by impurities contained in the carrier gas. The experiments were run for the duration of 20 hours at most. 25X1

55. UF_6 was used as feed gas. A fluorine-treated high-molecular oil, which was delivered from Moscow, served as carrier substance. The Soviets are believed to have developed this oil for lubricating purposes in pumping systems.

56. During the first two years, Hertz operated with one separating stage only. Initially there was no possibility to assay the degree of enrichment. The first experiments seemed promising. But these first favorable results were never repeated. It was rumored that Hertz had been deceived by faulty computations. Hertz himself persistently believed in his method. He admitted that technical difficulties were to be taken into account, but he kept repeating that he was a mere scientist. Barwich on his part always doubted the efficacy of Hertz' countercurrent flow system.

57. [redacted] 25X1

58. The Soviets were greatly interested in Hertz' separation method since his construction involved no mobile parts and had a very low energy balance. Around the turn of the year 1950/51, there were rumors of their constructing their own pilot cascade. Soviet engineers from Leningrad visited the institute for some 3 months and carefully studies Hertz' method. They prepared their engineering data on the spot. No information as to when and where such a plant has been erected is available.

59. In the autumn of 1952, Hertz was transferred to Moscow and lodged in the "house on the lakeside". He took with him all his papers and obviously continued his separation work at Laboratory 2. Before the year was out, he ordered delivery of pumps and vacuum soldering furnaces from Agudzeri.

60. [redacted] it may be assumed that Hertz' separation project was not developed to production scale as late as the autumn of 1953. 25X1
[redacted] 25X1
[redacted] After the autumn of 1953, 25X1
difficulties were no longer mentioned.

Barwich's isotope separation project

61. After Hertz' departure from Agudzeri, the separation project was assigned to Barwich. Although he was said to disagree with Hertz' method, he proceeded along the same line. But instead of UF_6 he made use of lighter gases and aimed at working with BF_3. Shortly

after having performed his first experiments, he claimed to have reached great progress by working at atmospheric pressure instead of low pressures. Steam was used as carrier gas. He claimed to have reached satisfactory results with a two-stage unit. He constructed a 50-stage unit which, however, proved a failure, allegedly because of its inadequate pumping system. Barwich also made use of copper cylinders 4 cm in diameter and 20 cm high. The cylinder which contained the diaphragm tube rested on the boiler, the vapor was fed into the cylinder through a tube. The whole system resembled a mercury diffusion pump.

62. [redacted] 25X1

Work performed by Muehlenpfordt

63. In mid-1948, Muehlenpfordt was ordered to set up a large-scale copy of Hertz' separation plant. Muehlenpfordt took to a different engineering line. [redacted] 25X1
[redacted] The unit consisted of 2 square vacuum 25X1
containers each 1.5x1.5 meters across and 0.5 meter high. Each tank was filled with carrier oil and accomodated a condenser fitted with the diaphragm. UF_6 was also fed into these containers. Subsequently the containers were closed and evacuated.(sic!) The pressure was estimated at 20 Thor. The apparatus operated for the durection of 80 days. The separation product was taken off in frozen condition. After termination of the experiment, the diaphragms appeared clogged and dirty. A Soviet named Andreyev (fnu) (phonetic spelling), a co-worker of professor Kikoyen, was said to have operated a similar system at Laboratory 2. Initially the results of Muehlenpfordt's experiments were poor, but later he was said to have "stolen the show" with his construction. Muehlenpfordt's work was believed to have been designed for controlling Andreyev's activities. [redacted] 25X1
[redacted] 25X1
the method employed was Hertz' countercurrent flow method. Muehlenpfordt also conducted extensive corrosion tests with his system.

Determination of grain sizes

64. [redacted] 25X1
[redacted] Initially the Soviets 25X1
were not interested in scientific research on grain sizes of powders used in the manufacture of diaphragms. A female Soviet physicist from Yermin's staff was to have charge of this work. She was a ceramics expert and experienced in questions of the effects of grain size on the porosity of ceramic substances.

[redacted] 25X1

[redacted] 25X1
With the aid of a light-optical microscope it was possible to examine the individual grains. The radiographical method worked with a powder mixture which was irradiated with copper rays. From the different shadings and lines appearing on the film strip, it was possible to draw up a formula of the grain sizes. It must be taken into consideration, however, that such a formula indicates apparent values only. Actual values are obtained by deducting a factor established by the component voltage (sic!). [redacted] 25X1 25X1 25X1
The standard grain size was around 0.1μ. Examination of nickel carbonyle as used by Thiessen showed a grain size of approximately 1μ.

65. [redacted] 25X1

Manufacture of extra-fine nickel foils

66. In the summer of 1951, Moscow requested the manufacture of extra-fine nickel foils, which were believed to be required for the manufacture of neutron counters. The foil was to be vacuum-tight and thinner than 1μ. [redacted] 25X1 25X1 25X1 Two ways of approach were considered, one involved nickel vacuum-coating, the other nickel-electroplating. [redacted] 25X1 25X1

67. A thin copper foil was etched with nitric acid and subsequently electroplated with a thin nickel film. The electrolyte had a p^H of 4 or 5, and the process lasted for 1 or 2 minutes. Clamped in a plexiglass frame, the copper was dissolved from the foil either by electrolysis or by treating it with nitric acid. The nickel foil thus obtained was about the size of a match box, it was pore-free and transparent, and of 500 to 600 angstrom.

68. [redacted] 25X1 25X1 Production of foils according to this method was continued there until 1953. The foils were shipped to Moscow. It is essential in this method to use oxide-free copper. This was accomplished by the etching process.

Manufacture of aluminum diaphragms

69. Following her husband's suggestions, Mrs. Kortsava prepared a thesis on the manufacture of aluminum diaphragms. It was his idea to produce holes (pores) in anodically oxidized diaphragms. It had been known for two years that aluminum is resistant to corrosion by UF_6, and the use of aluminum diaphragms had occasionally been discussed.

70. In order to be able to conduct experiments in this field, Kortsava furnished [redacted] aluminum foils about 0.08 μ thick. These foils were oxidized in an oxalic acid electrolyte until transparency was reached. The first experiments yielded aporous foils. It was shown that the oxidation process acting on either face of the foil failed to pierce the material. Moreover, the material became very brittle. [redacted] rolling an aluminum foil of 10,000 loops per sq.cm. with a superimposed nickel screen. The crossing points of the nickel wire left their impressions on the aluminum foil. Clamped in a frame, the foil was subsequently immersed into an electrolytic cell with an electrolyte on one side and pure water on the other. Electrolysis was carried out until the impressions left by the nickel screen became translucent. This treatment left the foil pliable and a good porosity was attained. 25X1 25X1 25X1

71. Measuring results of these foils made by Zuehlke were satisfactory. [redacted] their porosity was 10 percent above the results reached by the other diaphragms developed in Agudzeri. 25X1

[redacted] 25X1

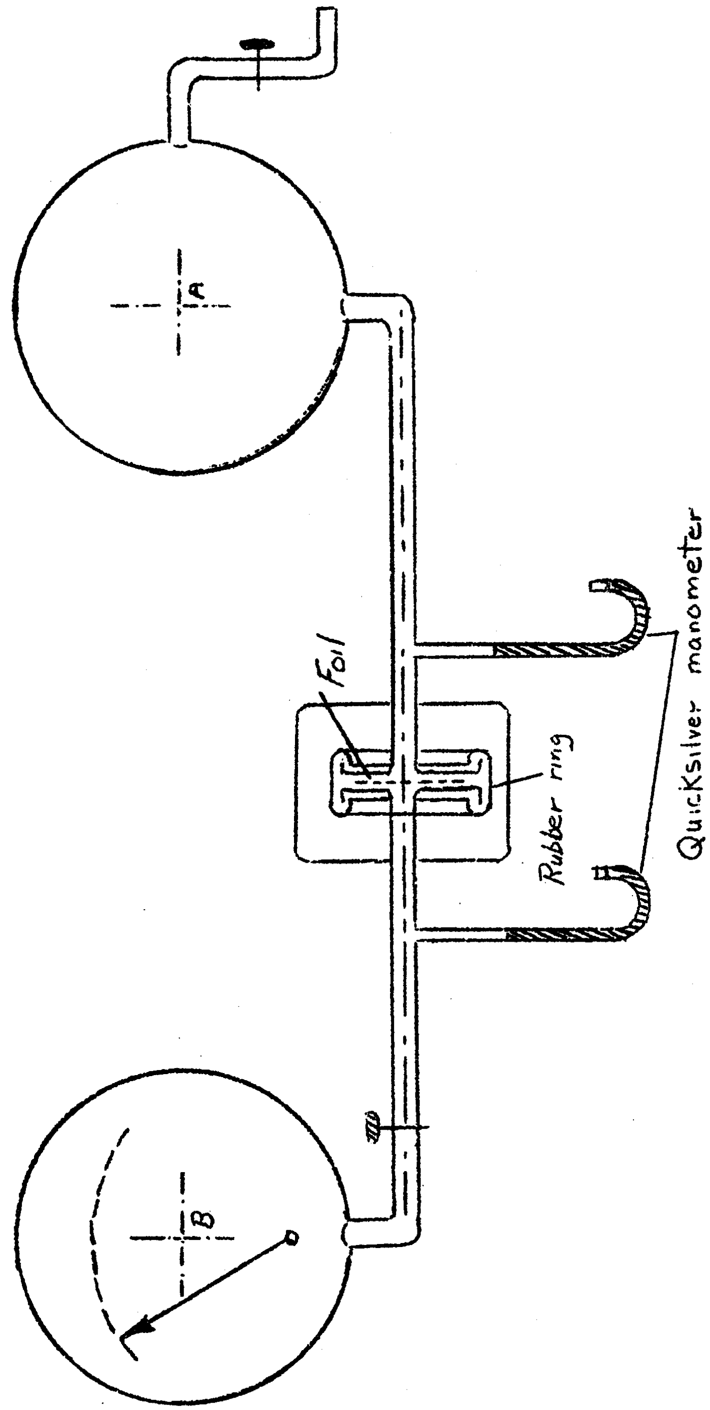
1. [redacted] Comment. For schematic diagram of porosity measurements according to Hertz, see Annex 1. 25X1

2. [redacted] Comment. For sketch of the holder tube of Reichmann diaphragm and assembly of the diaphragm in the cascade, see Annex 2. 25X1

3. [redacted] Comment. For sketch of the vacuum soldering furnace, see Annex 3. 25X1

[redacted] 25X1

Schematic Diagram of the Hertz Method for Measuring Porosity



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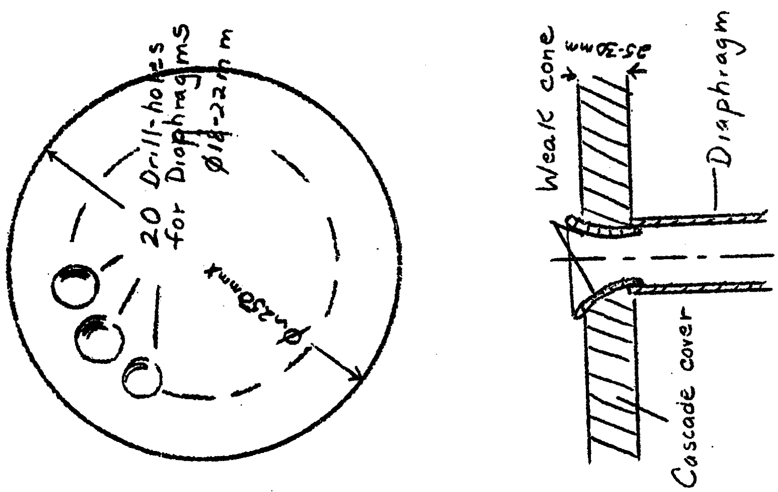
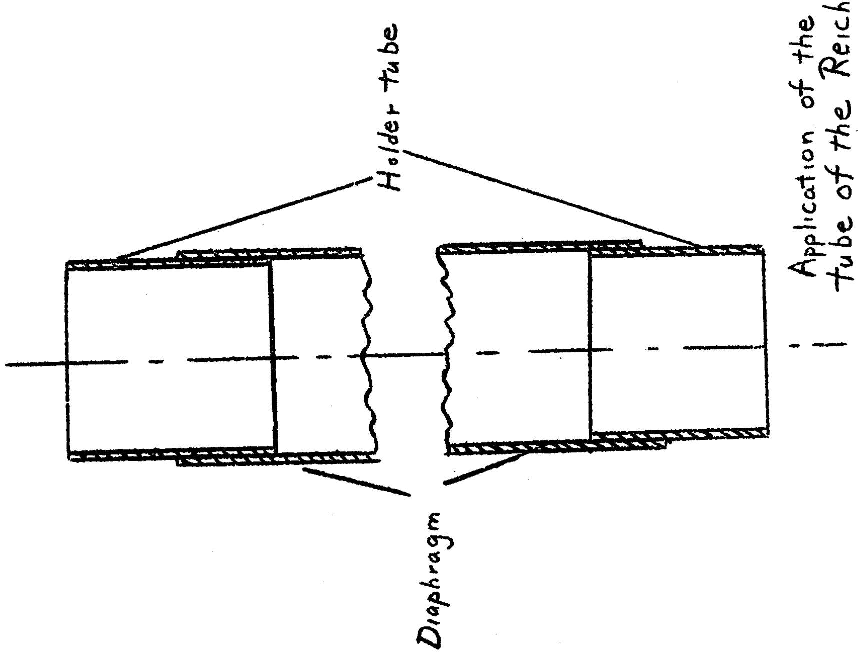


Mounting of the Reichmann Diaphragm in the cascade



Application of the holder tube of the Reichmann diaphragm

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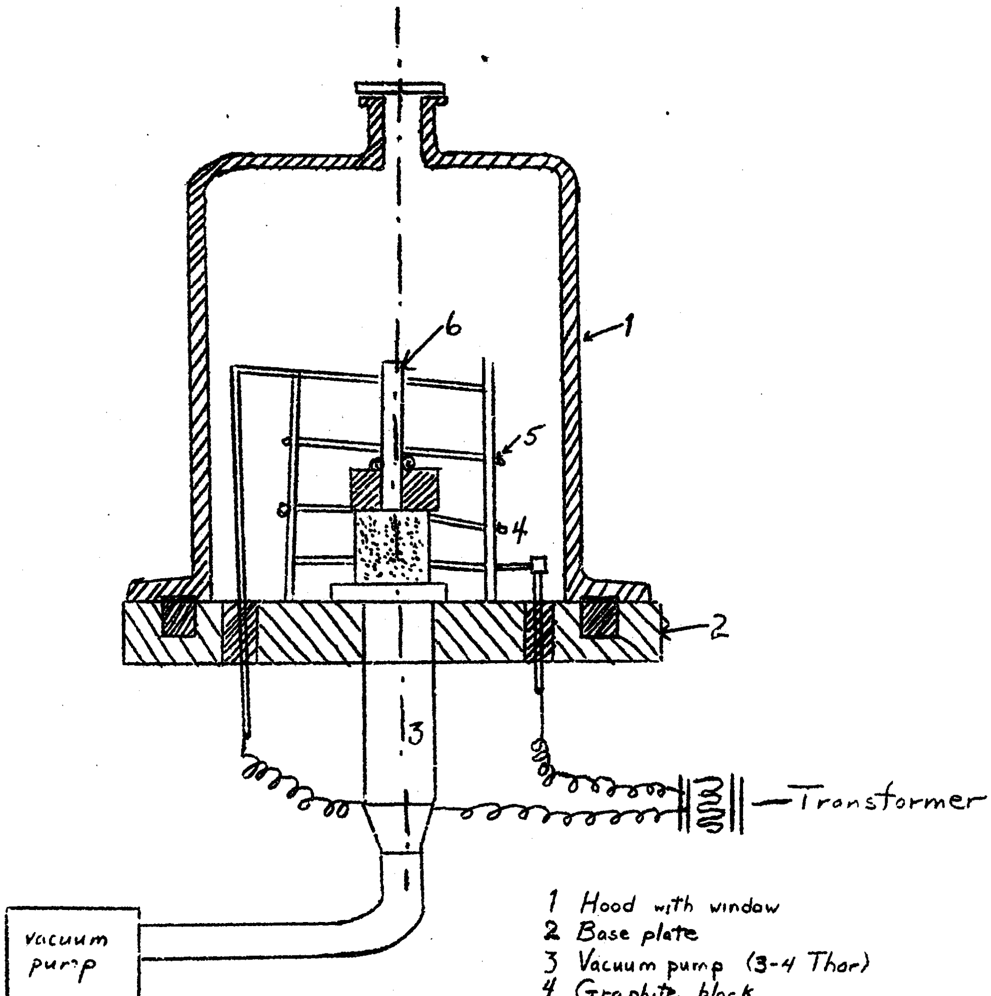

1 Hood with window
2 Base plate
3 Vacuum pump (3-4 Thor)
4 Graphite block
5 Heating element
6 Component to be soldered

1 and 2 are water coolers

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